

Publication date: 01.12.2021

DOI: 10.51871/2588-0500_2021_05_04_10

UDC 159.9.072

FEATURES OF PSYCHOLOGICAL EXPERIENCE OF 7-11 YEAR OLD ATHLETES WITH DIFFERENT TYPES OF VEGETATIVE REGULATION

M.S. Sevost'yanova^{1,2}, I.O. Loginova², E.V. Semichev³

¹Federal Siberian Research Clinical Centre of the Federal Medical Biological Agency, Krasnoyarsk, Russia

²V.F. Vojno-Yasenetskij Krasnoyarsk State Medical University, Krasnoyarsk, Russia

³Research Institute of Molecular Medicine and Pathobiochemistry of the V.F. Vojno-Yasenetskij Krasnoyarsk State Medical University, Krasnoyarsk, Russia

Key words: children's sports, adaptive reserves, autonomic regulation, heart rate variability, psychoemotional stress, stress.

Annotation. The aim of the study was to examine the specificity of psychological experience of 7-11 year old athletes with various types of vegetative regulation. It was found that only 52,4% of children can be attributed to the III group. This group has a moderate predominance of the parasympathetic and autonomic regulation of the heart rate, which is traditionally favorable for engaging in sports. Athletes of the I, II, IV groups showed stronger psychoemotional stress. It has been proven that the central type of regulation is a risk factor for reduced adaptation and health at the stage of initial sports specialization and in-depth training in the chosen sport. Thus, it is important to create programs for the prevention of psychological disorders, taking into account these characteristics.

Introduction. In order to increase effectiveness of the training process of young athletes, preserve their physical and mental health, overcome successfully the crisis of the initial sports specialization (7-9 years) and the crisis of transitioning to in-depth training in the chosen sport (12-13 years), and prevent dysfunctional states, rational planning of the annual sports cycle considering individual psychological features, a type of vegetative regulation, initial functional state and adaptive reserve capabilities of a specific child's organism is deemed important. Currently when observing health indicators of athletes, conclusions on a sufficiency of adaptation reserves, an adequacy of the vegetative nervous system's functioning, a degree of physiological stress and risks of adaptation failure can be formed on the basis of systematic analysis of the heart rate variability (HRV) indicators. This method is modern, reliable and available [1-8].

Contrary to the popular belief that intense sports sessions at an early age contribute to health improvement, training of will and strength of spirit, experts consider excessive physical loads as an etiological factor of the vegetative dysfunction syndrome (VDS), the occurrence of which amounts to 60% among schoolchildren and 82% among adolescents. Young athletes are not an exception. Relevance of the VDS in pediatrics and neurology is due to the fact that this state is characterized by a high risk of chronic diseases of different organs and systems. A long-term psychoemotional stress for modern children, increasing by the age of 7-11 years under the influence of a wide range of factors (conflicts in family and school, toxic upbringing, bullying, fatigue, insufficient work and rest routine, personal anxiety, depression etc.) combined with disorders in vegetative balance lead to a formation of psychosomatic diseases. These diseases are related to a depletion of self-regulation processes, “a development of the state of overstrain and weakness with a subsequent transition to the premorbid state and disease” [9]. Since these states can be considered as psychophysiological and potentially treatable at early stages, it is reasonable to diagnose vegetative disorders timely and treat them, considering accordingly the psychological correction of chronic stress [9]. According to N.I. Shlyk, risk of the organism overstrain is higher in primary schoolchildren. By the age of 7-11 years, the type of vegetative regulation, identification of which allows predicting capabilities of the organism adaptation, is already formed. Thus, as a result of a long-term observation, it was discovered that 11-year old children with the central type of regulation have a higher level of stress in regulation systems. To support a normal level of functioning of the cardiovascular system, they had to make more effort compared to 7-year old children with the autonomic type of vegetative regulation. That is the reason why it would be appropriate to select children with a moderate predominance of the autonomic curve of vegetative regulation, which is considered as a “complete physiological “platform” for engaging in sports” [10].

Now the truth is that “the “clinical” approach is not able to reveal overstrain and overtraining at early stages of their formation in case of excessive training loads” [11]. Among conditionally healthy 7-11 year old children, who were allowed to engage in sports (there was no organic pathology in organs and systems), a number of those who seek help of a medical psychologist due to physiological and psychological symptoms that correspond with the VDS and fatigue’s clinical pattern, constantly grows. For example, they complain about a rapid heartbeat, extremity coldness, pain when inhaling, nausea, discomfort in the abdominal area, dizziness, pale or red skin and headache of unclear genesis. Among common psychological symptoms, parents and coaches also note unreasonable fear, anxiety (when coming

out of the room, going to school etc.), absent-minded behavior, high distractability, peevishness, bad moods, drowsiness, apathy, tearfulness, affectivity etc.

The aim of the study was to examine the specificity of psychological experience of 7-11 year old athletes with various types of vegetative regulation. In this case, “experience” means emotional and physical states caused by severe feelings and impressions.

Methods and organization. The total selection included 70 children aged 7-11 years who engage in sports (intensity of physical loads is considered as high or very high) and who consulted the medical psychologist due to appeared psychological difficulties in the training process, pre-competition and competition periods. The experiment was carried out in the FSBI FSRCC of the FMBA of Russia. Evaluation of the functional state using the HRV method was conducted with the “Multispectrum” apparatus. We ran diagnostics of the specificity of emotional distress associated to sports activity using the PES (psychoemotional stress) questionnaire (“Dynamic evaluation of the psychoemotional stress in children’s sports”) [12]. Meanwhile, parents were filling a checklist of VDS symptoms (the authors’ method): according to the instruction, they needed to note physiological and psychological symptoms that were noticed in a child not less than 1 time a week for the last month. Data processing was made using mathematical statistics methods (Mann-Whitney-Wilcoxon U-test) in the StatGraphics Plus program. In order to preserve steadiness of registering HRV and balance consequences of influence made by situational stress, external disruptions and other psychoemotional loads, we interpreted data of three repeated HRV recordings. Further analysis excluded test subjects who have disparities in types of vegetative regulation in received cardiointervalographs. The final selection included 63 test subjects.

Results and discussion. We carried out a selection distribution based on types of vegetative regulation with SI (stress index) and VLF (very low frequency) indicators in accordance with the suggested classification (Shlyk N.I., 2003) (table 1).

The HRV analysis was carried out in accordance with methodological guidelines [13-14]. The HRV characteristics (mean values) in 7-11 year old athletes with different types of vegetative regulation are presented in table 2.

Table 1

Selection distribution (n=63) based on types of vegetative regulation according to SI and VLF indicators

Group	Type of heart rhythm regulation	Amount of respondents
I	Moderate predominance of the sympathetic and central regulation (SI (c.u.)>100; VLF (ms ²)>240) – MCR	15 (23,8%)
II	Pronounced predominance of the sympathetic and central regulation (SI (c.u.)>100; VLF (ms ²)<240) – PCR	6 (9,5%)

Table 1 (continued)

III	Moderate predominance of the parasympathetic and autonomic regulation ($25 < SI \text{ (c.u.)} < 100$; $VLF \text{ (ms}^2) > 240$) – MAR	33 (52,4%)
IV	Pronounced predominance of the parasympathetic division and autonomic regulation ($SI \text{ (c.u.)} < 25$; $VLF \text{ (ms}^2) > 500$ when $TP \text{ (ms}^2) > 8000$) – PAR	9 (14,3%)

Note: SI – stress index; VLF – very low frequency; MCR – moderate central regulation; PCR – pronounced central regulation; MAR – moderate autonomic regulation; TP – total power of the spectrum; PAR – pronounced autonomic regulation

Table 2

Comparative analysis of the HRV characteristics among 7-11 year old children with different types of vegetative regulation

HRV spectral characteristics	Groups based on types of vegetative regulation			
	I	II	III	IV
TP (ms ²)	1239±249,7	376,0±97,4	5927,6±282,6	10004,0±1026,5
VLF (ms ²)	557,8±150,0	150,0±42,7	1626±148,5	998,3±267,2
LF(ms ²)	394,6±148,2	61,0±29,5	1497,4±187,6	2859±335,7
HF(ms ²)	286,8±203,6	165,0±25,1	2803±197,3	6146,0±1101,7
VLF%	45,8±12,8	40,0±1,9	28,8±7,2	11,0±3,06
LF%	32,2±12,0	15,5±3,8	26,2±10,8	31,1±6,0
HF%	21,6±13,1	45,0±4,3	45,2±22,7	58,0±10,5
LF/HF	2,2±1,6	0,35±0,12	0,89±0,13	0,57±0,22
SI (c.u.)	219,8±68,2	385,8±157,6	54,7±20,2	21,6±1,8

Note: TP – total power of the spectrum; VLF – very low frequency; LF – low frequency; HF – high frequency; SI – stress index

According to data presented by N.I. Shlyk, a moderate predominance of the central regulation is steadily preserved for 3 years in 80% of children in case of repeated recording. It allows assuming a slowed-down maturation of the parasympathetic regulation in children of the I group, a predominance of vasomotor waves over the pulmonary waves and, consequentially, a decrease of psychophysiological adaptation reserves and constant stress of regulatory systems. The inheritance factor and psychoemotional stress that disturbs functioning of the limbic-reticular complex play an important role in increasing sympathetic activity of the II group children. Special attention should be given to the LF/HF indicator, the mean value of which is higher than the normal one in the I group, since this is the exact indicator that should be considered as a physiological indicator of the “psychosomatic” risk, as this indicator defines the vagosympathetic balance. Persistent value of this indicator on a level of $\geq 1,5$ demonstrates a long-term functioning of the organism in conditions of internal stress, which, in the long run, leads to a formation of reversible and then irreversible organ diseases [15]. The pronounced predominance of the parasympathetic division and the autonomic regulation (the IV group) can be considered as a high training level (physiological option), as well as an evidence of overstrain and overtraining, especially if $SI < 10$ c.u. and $TP > 16000 \text{ ms}^2$. However, at the age of 7-11 years, this type of regulation is

attributed to an unsatisfactory functional state of systems regulating the heart rate [10]. Therefore, athletes of the I, II, IV groups require increased attention and observation during the training and competition process.

At the next stage, we analyzed features of the psychoemotional stress of children associated with sports activity. Since in this case, traditional methods of research (CMAS, CDI etc.) do not possess a sufficient degree of sensitivity, we used the specialized PES questionnaire. It allows defining the “plane” of sports career (motivation, participating in competitions, injury rate etc.), in which intense psycho-traumatic experience cases of a young athlete are located most frequently, and objectify the dominating psychological conflict. Results of the PES method’s diagnostics are demonstrated in the table 3 (0-12 points, the higher the point, the higher is the stress level and more intense the degree of psychoemotional stress in this field; values higher than 6 indicate the necessity of urgent psychologically corrective intervention).

Table 3

Comparative analysis of the specificity of psychological experience of 7-11 year old athletes with different types of vegetative regulation

Examined fields (the PES questionnaire scales)	Groups based on types of vegetative regulation			
	I	II	III	IV
1. Attitude to the training process	5,2±1,1	2,5±0,7	1,9±0,7	2,2±0,3
2. Attitude to competitions	7,2±1,3	9,5±0,5	4,2±1,6	5,7±2,2
3. Relationship and interaction with parents	4,8±1,0	7,0±1,0	5,6±2,1	3,9±1,2
4. Perception of the coach figure and interaction with the coach	4,4±1,1	4,5±1,8	3,1±1,8	3,3±1,4
5. Attitude to loss and failures in sports	5,6±1,7	7,0±1,1	5,3±1,3	5,9±2,5
6. Self-confidence and belief in oneself	8,0±2,2	4,6±1,6	4,0±2,1	6,0±1,8
7. Injury rate in sports and its consequences	2,8±0,7	7,3±0,9	4,3±1,2	2,2±0,1
8. Vegetative signs and psychosomatic reactions	5,2±1,8	8,2±2,2	4,1±1,7	4,1±1,9
9. Dysfunctional states of training	7,4±2,9	5,2±1,4	2,6±0,9	3,7±1,8
10. Motivation and sense of activity	4,8±1,0	2,5±0,7	1,6±0,3	2,1±0,2
11. Total level of psychoemotional stress	55,4±13,6	57,5±11,2	37,2±14,9	39,1±16,3

The table shows that general level of psychoemotional stress is higher in athletes of the I and II groups with predominance of the sympathetic regulation, which is also proven statistically: $U=630,0$ ($p=0,023$) when comparing II and III groups and $U=841,5$ ($p=0,053$) when comparing I and III groups respectively. Attention should be drawn to areas, in which average point in scales was ≥ 6 . Among athletes of the I group these are the scales number 1, 6 and 9, which indicates a typical for children with the MCR decrease of adaptation during the pre-competition and competition period (mostly like pre-start jitters) related to a negative attitude to their own capabilities, denying personality traits and skills contributing to the achievement of maximum sports result. It also indicates a high risk of such

worsening unsatisfactory training states as overstrain, deprivation, psychological saturation, monotony and frustration. For children of the II group these are the scales number 2, 3, 5, 7, 8, which demonstrates a presence of the whole complex of negative pre-start experience (pronounced “fever”) in children with PCR that is also accompanied by an irrational attitude to loss and failures in sports (a child makes inflated, unrealistic requirements and demands to themselves, dwells on failures, it is difficult for them to acknowledge positive experience and set new goals, they also have an unhealthy fixation on an opponent etc.), fear of injury and ending their career, not justifying parents’ expectations or being punished. This emotional experience strengthens the sense of anxiety and stress, worsening vegetative symptoms and signs of stress. Among children with PAR (IV group), psychological distress is less pronounced and defined in reduced belief in oneself and self-confidence. It is notable that symptomatic manifestations of the VDS (we considered cases of registering $6 \leq$ physiological and psychological signs) are noticed also by parents of children of the I and II groups in comparison with the III group (73,3%, 83,3% and 24% respectively).

Conclusion. Results of the conducted study demonstrated that from the perspective of the effectiveness of psychological adaptation of children to training and competitive activity at the age of 7-11 years, the most favorable is the type of vegetative regulation with a moderate predominance of the parasympathetic and autonomic curve of regulation. High intensity of psychoemotional stress in children of the I, II, IV groups allows considering these types of vegetative regulation as a risk factor of psychological maladaptation in sports activity at the stage of initial sports specialization and in-depth training in the chosen sport. Understanding specificity of psychological experience of children with different types of vegetative regulation should be based on creating specialized programs for preventing maladaptation disturbances and states in young athletes. The data received confirm the idea that currently there is a dire need in reconsidering the set of views on constructing the training process in whole [10]. The individual approach in children sports cannot be implemented fully without considering the type of functional state of regulation systems and features of the psychoemotional field of a specific athlete.

References

1. Bokeria L.A. Heart rate variability: measurement methods, interpretation, clinical use / L.A. Bokeria, O.L. Bokeria, I.V. Volkovskaya // *Annals of Arrhythmology*. – 2009. – Vol. 6. – № 4. – P. 21-32.
2. Gavrilova E.A. Sport, stress, variability: a monograph / E.A. Gavrilova // M.: Sport. – 2015. – 168 p.

3. Kolomiets O.I. Heart rate variability during adaptation to physical loads of various directions / O.I. Kolomiets, E.V. Bykov // Scientific Notes of the P.F. Lesgaft University. – 2014. – № 12(118). – P. 98-103.

4. Kudrya O.N. Assessment of the functional state and physical fitness of athletes according to the heart rate variability indicators / O.N. Kudrya // Bulletin of the Novosibirsk State Pedagogical University. – 2014. – № 1(17). – P. 185-196.

5. Shlyakhto E.V. National Recommendations for determining the risk and prevention of sudden cardiac death / E.V. Shlyakhto, G.P. Arutyunov, Yu.N. Belenkov, S.A. Bojtsov // Cardiology: News, Opinions, Training. – 2019. – Vol. 7. – № 1. – P. 64-88.

6. Nikulina A.V. Alterability of the heart rate variability as a reflection of the implementation of physiological mechanisms of adaptation of the organism / A.V. Nikulina, V.A. Kozlov, A.A. Shukanov // Human. Sport. Medicine. – 2017. – Vol. 17. – № 4. – P. 14-20.

7. Gorelik V.V. Features of psychophysiological adaptation of 11-16 year old schoolchildren to educational and physical loads, determined by the types of their vegetative regulation / V.V. Gorelik, V.S. Belyaev, S.N. Filippova, B.N. Chumakov // Human. Sport. Medicine. – 2018. – Vol. 18. – № 1. – P. 20-32.

8. Moe B. Occupational physical activity, metabolic and risk of death from all causes and cardiovascular disease in the HUNT 2 cohort study / B. Moe, P.J. Mork, A. Holtermann, T.I. Nilsen // Occup Environ Med. – 2013. – Vol. 70. – № 2. – P. 86-90. DOI: 10.1136/oemed-2012-100734.

9. Batyshev T.T. Syndrome of vegetative dysfunction in children and adolescents: clinical signs, diagnosis and treatment. Methodological guidelines in 2 parts / T.T. Batyshev, K.A. Zajtsev, M.N. Sarzhina, O.V. Kvasova, N.V. Chebanenko // Moscow. – 2015.

10. Shlyk N.I. Heart rate and type of regulation in children, adolescents and athletes: a monograph / N.I. Shlyk // Izhevsk: Publishing house "Udmurt University". – 2009. – 259 p.

11. Shlyk N.I. Management of the training process of athletes considering individual characteristics of the heart rate variability / N.I. Shlyk // Human Physiology. – 2016. – Vol. 42. – № 6. – P. 81-91.

12. Sevostyanova M.S. On the problem of objectification of psychological diagnostics of neuropsychic stress in children's sports / M.S. Sevostyanova // XVI International Interdisciplinary Congress "Neuroscience for Medicine and Psychology", October 9-16, 2020. – Sudak, Crimea. – 2020. – P. 410.

13. Baevskij R.M. Analysis of heart rate variability when using various electrocardiographic systems (guidelines) / R.M. Baevskij, G.G. Ivanov, L.V. Chireikin, A.P. Gavrilushkin, P.Ya. Dovgalevskij, Yu.A. Kukushkin,

T.F. Mironova, D.A. Prilutskij, Yu.N. Semenov, V.F. Fedorov, A.N. Fleishman, M.M. Medvedev // *Bulletin of Arrhythmology*. – 2001. – № 24. – P. 65-82.

14. Khodyrev G.N. Methodical aspects of the analysis of temporal and spectral indicators of the heart rate variability (literature review) / G.N. Khodyrev, S.V. Khlybova, V.I. Tsyarkin, S.L. Dmitrieva // *Vyatka Medical Bulletin*. – 2011. – № 3-4. – P. 60-70.

15. Samikulin P.N. Changes in the heart rate variability as a response to muscular loads and their relationship with the concentration of steroid hormones in young men with different specificity of fitness / P.N. Samikulin, A.V. Gryaznykh, R.V. Kuchin, N.D. Nenenko // *Human. Sport. Medicine*. – 2018. – Vol. 18. – № 1. – P. 33-45. DOI: 10.14529/hsm180103.

Information about the authors: Maria Sergeevna Sevost'yanova – Candidate of Psychological Sciences, Master-level Medical Psychologist, Head of the Psychology Department at the Federal Siberian Research Clinical Center of the Federal Medical and Biological Agency, Krasnoyarsk, Lecturer of the Department of Clinical Psychology and Psychotherapy at the V.F. Vojno-Yasenetskij Krasnoyarsk State Medical University, e-mail: SevostyanovaMS@yandex.ru, ORCID ID: 0000-0001-5084-0460; **Irina Olegovna Loginova** – Doctor of Psychological Sciences, Professor, Head of the Department of Clinical Psychology and Psychotherapy of the V.F. Vojno-Yasenetskij Krasnoyarsk State Medical University, Krasnoyarsk, e-mail: loginova70_70@mail.ru; **Evgenij Vasil'evich Semichev** – Doctor of Medical Sciences, Leading Researcher of the Research Institute of Molecular Medicine and Pathobiochemistry of the V.F. Vojno-Yasenetskij Krasnoyarsk State Medical University, Krasnoyarsk, e-mail: evsemichev@yandex.ru, ORCID ID: 0000-0003-2386-5798.